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ABSTRACT

Some commentators have argued that the housing crisis may harm labor markets because homeowners who owe more than their homes are worth are less likely to move to places that have productive job opportunities. I show that, in the available data, negative equity does not make homeowners less mobile. In fact, homeowners who have negative equity are slightly more likely to move than homeowners who have positive equity. Ferreira, Gyourko and Tracy's (2010) contrasting result that negative equity reduces mobility arises because they systematically drop some negative-equity homeowners' moves from the data.

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1. Introduction

The decline in housing prices over the past several years has left many homeowners owing more on their mortgages than their houses are worth. As of the summer of 2010, about 10 percent of all housing units were occupied by owners who had negative equity.[1] Ferreira, Gyourko, and Tracy (2010, hereafter FGT) report that homeowners who have negative equity are one-third less likely to move. This finding, in combination with the wide dispersion in unemployment rates across the country, has raised concerns that the weak housing market is keeping unemployment high by preventing homeowners who have negative equity from moving to better job markets (e.g., Batini et al., 2010; Fletcher, 2010; *The Economist*, 2010).[2]

In this paper, I argue that the concerns are misplaced. I show that FGT found fewer moves among negative-equity homeowners because FGT systematically drop some negative-equity homeowners' moves from the data. FGT analyze data from the U.S. Census Bureau's American Housing Survey (AHS), which is a panel survey of homes. AHS surveyors go to the same homes every two years and record who lives there. Consider a house that is owner occupied in 2005. Four outcomes are possible in 2007: (1) the house is occupied by the same owners as in 2005; (2) it is occupied by different owners; (3) it is occupied by different

[1] Estimates of the fraction of mortgages that are under water vary but are generally around 23 percent. Zillow (2010) estimated that 23.2 percent of single-family homeowners with mortgages had negative equity in the third quarter of 2010, while CoreLogic (2010) estimated that 22.5 percent of homes with mortgages had negative equity at the end of the second quarter. According to 2009 American Community Survey data — the most recent available from the U.S. Census Bureau — 66 percent of housing units are owner occupied, and 68 percent of owner-occupied units have mortgages. Thus, the CoreLogic and Zillow estimates imply that about 15 percent of owner-occupied homes have negative equity and about 10 percent of housing units are occupied by owners with negative equity.

[2] FGT are not the only authors who have studied the effect of negative equity on mobility. Chan (2001) finds that homeowners with negative equity are less mobile. Engelhardt (2003) finds that nominal loss aversion reduces mobility, but low equity due to house price declines does not reduce mobility. However, as FGT point out, these papers use geographically and demographically restrictive samples, and it is important to examine nationally representative data.

people, who are renters; or (4) it is vacant.[3] FGT shared their computer code with me, and I examined how they treat these four cases. Uncontroversially, FGT code (1) as indicating that the 2005 occupants did not move and (2) as indicating that the 2005 occupants moved. However, when (3) or (4) occurs, FGT code the "moved" variable as missing and drop the observation from the sample. This coding assumes that people with negative equity are no more likely than people with positive equity to leave a house vacant or rent it out when they move. If, instead, people with negative equity are more likely to leave a house vacant (perhaps due to foreclosure) or rent it out (perhaps because they prefer to hold the property in hopes it will appreciate), then FGT will systematically drop negative-equity moves from the sample and will mistakenly conclude that negative-equity homeowners move less than they actually do. In this paper, I reanalyze FGT's data, but I recode cases (3) and (4) — renters and vacancies — as moves, since the homeowners did indeed move in these cases. I find that with this change in coding, negative-equity homeowners are *more* rather than *less* likely to move.

Theoretical predictions about the effect of negative equity on mobility are ambiguous. People with negative equity may be liquidity constrained and unable to move unless they default on the loan, which they may prefer not to do for a variety of reasons. Down payment requirements for mortgages may also prevent liquidity-constrained negative-equity homeowners from buying comparable houses if they move. Further, owning a house with negative equity is like taking a highly leveraged position in the real estate market; the owner may want to continue holding the house in hopes of making a large gain if the house appreciates

[3] I discuss in section 2 how the AHS records occupancy status when no one is home to be interviewed and how I handle the possibility that owner-occupants become renters while remaining in the same house.

(Foote, Gerardi, and Willen, 2008). On the other hand, if sufficient appreciation to repay the loan is unlikely, the owner's best choice may be to default, especially if the loan is nonrecourse (Ghent and Kudlyak, 2010). In addition, even if it is optimal to hold the house as an investment, owners can still move if they find tenants to rent the property. It is ultimately an empirical question whether the forces that reduce mobility are stronger or weaker than the forces that increase mobility. My analysis shows that, in the available data, the forces raising mobility are stronger.[4]

I use the theoretical predictions as a further check on the results. The more negative a homeowner's equity becomes, the greater the benefits of default, and the lower the likelihood that prices will rise enough to cover the debt. Thus, all else equal, homeowners with extremely negative equity should be more likely to move than homeowners with slightly negative equity. I show that the data bear out this theoretical prediction when using my coding of moves but not when using FGT's coding. Using my coding, homeowners with extremely negative equity are more mobile than those with slightly negative equity, whereas using FGT's coding, homeowners with extremely negative equity are less mobile than those with slightly negative equity. However, because the sample size is small, these differences are not statistically significant.

One must be cautious, of course, in extrapolating from my findings to the current

[4]FGT's data do not reveal why homeowners moved or whether they sold the house, rented it out or suffered foreclosure, so I cannot use the data to determine which specific forces are at work. It is difficult to bring additional data to bear on the issue because few datasets measure homeowners' equity and their subsequent mobility and are large enough to contain a meaningful number of negative-equity homeowners. I have also analyzed the relationship between negative equity and mobility in the Survey of Income and Program Participation (SIPP), which is a panel survey conducted by the U.S. Census Bureau. In the SIPP, too, I found that negative-equity homeowners are more mobile. However, the migration variables in the SIPP contain coding inconsistencies, and the Census Bureau has not yet released corrected versions of the public-use data files for the SIPP that would permit an accurate analysis.

policy debate. FGT's data measure homeowners' equity in years ranging from 1985 to 2005. Negative equity was quite unusual until recently; people who have negative equity in 2010 may differ in a variety of ways from those who had negative equity four or more years ago, and negative equity may have different impacts on the mobility of different kinds of people.[5] Negative equity may also have different impacts in strong and weak economies, or in economies with different prevailing interest rates. Conclusive work on the impact of negative equity in the current environment will therefore have to wait until more recent data are available. However, based on available data, there appears to be no evidence that negative equity reduces homeowners' mobility. In addition, my findings are consistent with research that uses recent data to examine other aspects of the impact of negative equity. For example, Valletta (2010) finds that recent house price declines have had equal effects on the unemployment durations of homeowners and renters, contrary to what one would expect if negative equity makes it more difficult for homeowners to move for jobs.

The paper proceeds as follows. Section 2 shows how changing the coding of rented and vacant homes reverses FGT's results. Section 3 compares the mobility of homeowners with slightly negative and extremely negative equity. Section 4 concludes.

2. Consequences of coding choices in the FGT data

FGT's data come from the AHS, a panel survey of homes that records who lives in a given home — and an array of individual, household, and housing characteristics — every two years. FGT analyze the effect of having negative equity in year t on the probability that a household moves between t and $t + 2$. My focus here is on the definition of the mobility

[5]Because negative equity was so unusual until recently, the existing data do not contain enough negative-equity households to analyze heterogeneity in the effects of negative equity.

variable, and I refer the reader to FGT's paper for details on other aspects of their data. Since the goal is to study the mobility of homeowners, FGT restrict the sample for each year t to homes that are owner occupied in that year. FGT then measure mobility by examining who occupies the home in year $t + 2$.

As I explain in the introduction, FGT drop from the sample all cases where a house is owner occupied in year t but is vacant or rented[6] in year $t + 2$. I make only one change to FGT's data: I code these cases as moves.

It is important to consider how the AHS records data on homes where field representatives cannot interview any occupant, either because the home is vacant or because its occupants refuse to answer the survey. AHS field representatives collect data on vacant homes by interviewing "informed people such as landlords, rental agents, or knowledgeable neighbors" (U.S. Census Bureau, 1999, p. v). In these cases, the dataset's "interview status" variable records that the representative conducted a "vacant interview." If field representatives do not interview anyone, the status is "non-interview." The "tenure" variable, which records whether an occupied home is owner occupied or renter occupied, is usually based on occupants' responses to the survey and usually blank for vacancies and non-interviews. However, if the field representative determines that a home is occupied but cannot interview the occupants, the tenure variable is not blank. Instead, it is filled based on occupants' answers in past years or, if this is impossible, it is filled at random: 60 percent of cases are allocated to owners and 40 percent to renters (Vandenbroucke, 2008, p. 42).

FGT make a variety of careful editing changes to ensure that they can track owner-

[6]Throughout, when I refer to renters, I include the small number of non-owner households that occupy homes without payment of cash rent.

occupants from year to year even if data on the household are missing or incorrect in some years. Suppose that, after these changes, year t is the last year in which a certain household definitely occupied a given house. In coding whether the household moved between t and $t+2$, FGT treat randomly allocated data at $t+2$ identically to data based on interviews. Thus they retain cases where the year-$t+2$ tenure variable is allocated as owner occupied and drop cases where the year-$t+2$ tenure variable is blank or allocated as renter occupied.

In restoring owner-to-renter and owner-to-vacant transitions to the data, I consider four alternative codings of moves. For alternative 1, I follow FGT and treat allocated data identically to interview-based data. That is, if year t is a household's last known year in a home, alternative 1 codes the household as moving between t and $t+2$ whether the home is recorded as owner occupied, renter occupied, or vacant in year $t+2$, and whether these data are based on an occupant interview, a vacant interview, or allocation for a non-interview.

Alternative 1 runs the risk of mistakenly coding a move if the household did not move but simply failed to be interviewed and the Census Bureau allocated a renter occupancy or vacancy. According to the allocation procedures cited above, this error should never happen because the Census Bureau will fill in the tenure variable from the previous year's answer, which is "owner occupied." Nonetheless, I use a second alternative coding to verify that the results do not depend on how non-interview data are handled. Alternative 2 drops all cases where year t is a household's last known year in a home and the year-$t+2$ observation is a non-interview.

An additional risk with both alternative 1 and alternative 2 is that some renter occupancies at $t+2$ may involve households that were owner-occupants at t, sold the home to a new owner between t and $t+2$, and then rented the home back, thus remaining in place but

becoming renters at $t+2$. It is not possible to perfectly identify such cases in the data. The data for year $t+2$ include a variable, *SAMEHH*, that indicates whether any member of the year-t household is also an occupant in year $t+2$. According to this variable, the year-t and year-$t+2$ households overlap in about one-third of the switches from owner occupied to renter occupied. However, the AHS codebook reports that the *SAMEHH* variable can be inaccurate.[7] Also, if the *SAMEHH* variable is correct, one in every 65 house-year observations and one in every 11 owner-occupant transitions involve households selling their homes, renting them back, and not moving; it seems unlikely a priori that so many households sell their homes without moving. I thus view *SAMEHH* as giving an upper bound on which switches from owner to renter do not involve moves. As a robustness check, I consider alternative codings — $1'$ and $2'$ — where I code renter occupancies at $t+2$ as moves if *SAMEHH* shows that no member of the year-t household is present in year $t+2$; non-moves if *SAMEHH* shows that any member of the year-t household is present in year $t+2$; and missing in the small number of cases where *SAMEHH* is missing or recorded as "don't know." Alternative $1'$ is thus identical to alternative 1, and alternative $2'$ is identical to alternative 2, except that in each case I code some renter occupancies at $t+2$ as moves and some as non-moves, and drop others.

Table 1 lays out the possible data for year $t+2$, how many observations fall under each possibility, how FGT code each one, and how I code each one for alternatives 1, 2, $1'$, and $2'$. Table 2 shows how the coding changes disproportionately add moves by negative-equity

[7]See U.S. Department of Housing and Urban Development, 2009, pp. 489, 1267, and 1274. The codebook recommends comparing variables other than *SAMEHH* to accurately determine whether a household moved. FGT indeed use variables other than *SAMEHH* to identify moves. However, some of these variables, such as the purchase year, are collected only for owner-occupants, so they cannot be used to identify cases where a household did not move but changed from owning to renting.

homeowners. When homeowners with positive equity move, they are followed about two-thirds of the time by new owner-occupants (the cases FGT include) and about one-third of the time by renters or vacancies (the cases FGT drop). But when homeowners with negative equity move, they are followed only half of the time by new owner-occupants, and half of the time by renters or vacancies. Under alternative 1, including owner-to-renter and owner-to-vacant transitions as moves increases positive-equity households' moves by 51 percent, but the change more than doubles negative-equity households' moves. Under alternative 2, the coding change increases positive-equity households' moves by 36 percent and negative-equity households' moves by 78 percent. Even when I treat renter-occupancies as non-moves if the possibly inaccurate *SAMEHH* variable shows any overlap between the year-t and year-$t+2$ households, under alternatives $1'$ and $2'$, I still find that my coding change disproportionately increases negative-equity households' moves.

The raw data thus show that negative-equity and non-negative–equity homeowners are about equally likely to move by FGT's definition, but that negative-equity households are much more likely to move by the alternative definitions. Neither of these patterns reveals the causal effect of negative equity on mobility, however, because other factors might affect the propensity to move and might be correlated with negative equity. FGT control for other variables that might affect mobility by estimating a probit model of the form

$$\Pr\left(\text{household } i \text{ moves between } t \text{ and } t+2\right) = F(\mathbf{x}_{it}\boldsymbol{\beta}), \tag{1}$$

where $\mathbf{x}_{it}$ includes an indicator variable for whether household i has negative equity in year t as well as a set of demographic and economic controls: two financial variables that could reduce

the propensity to move — a measure of certain California property-tax benefits and a measure of whether the household has a fixed-rate mortgage at below-current rates; demographics; income; changes in demographics, income, and neighborhood quality between $t-2$ and t; a cubic in years in the house; MSA fixed effects; and region-specific and California-specific year effects.[8]

Table 3 reports the results of estimating the probit model using FGT's definition of moves and using the alternative definitions. Using FGT's definition, negative equity slightly but insignificantly reduces the probability of moving. Using the alternative definitions, negative equity *raises* the probability of moving by 1 to 3 percentage points, holding constant the household's demographics and its economic situation. Relative to the overall probability of moving in the sample, this is an increase of 10 to 18 percent. The increase in moves among negative-equity homeowners is significantly different from zero at the 5 percent level for three of the four alternative definitions.

FGT calculate equity from self-reported property values and mortgage balances. Because self-reported property values may be noisy estimates of true values, the negative-equity variable may be a noisy measure of whether a homeowner actually has negative equity. Such measurement error could bias the coefficient on the negative-equity variable toward zero. FGT try to correct the bias by constructing a second measurement of each homeowner's equity based on the original purchase price of the home and average home price appreciation in the metropolitan area in the years since the home was bought. FGT then use an instrumental variables (IV) probit estimator[9] and find that negative equity significantly reduces

[8]FGT do not use the sampling weights when estimating the model, and I do not do so here. In unreported results, I found that using the sampling weights does not appreciably change the results.

[9]Specifically, the "ivprobit" command in the Stata software package.

mobility. I do not report instrumental variables estimates with the alternative move variables for three reasons. First, the IV probit estimator is not valid when the instrumented variable — in this case, the indicator variable for negative equity — is binary (Wooldridge, 2002, p. 472). FGT's IV probit estimates thus do not reveal the causal effect of negative equity on mobility.[10] Second, because the mismeasured variable is binary, the measurement error here is not classical measurement error (where the measurement error is uncorrelated with the true value of the variable) but rather misclassification error. In such a situation, linear instrumental variables is not valid, either (Bound, Brown and Mathiowetz, 2001, p. 3732), so it would not be helpful to estimate a linear probability model with instrumental variables. Third, misclassification error can bias a coefficient toward zero but cannot change its sign, except if (a) the probability of misclassification exceeds 0.5 or (b) the true coefficient is small and statistically difficult to distinguish from zero. It seems unlikely that homeowners are so ill-informed about home values that they would report the sign of their equity incorrectly more than half the time. As for statistical significance, the probit estimates of the effects of negative equity on the alternative move variables are significantly positive, so a valid correction for measurement error would not be expected to produce negative coefficients in place of the positive ones.[11]

In sum, what the FGT data show is that homeowners who report having negative

[10] Constructing a valid correction for measurement error here is not trivial because FGT's probit model also includes two continuous explanatory variables that may be measured with error. The appropriate correction involves a system of four simultaneous equations, in which two dependent variables are continuous and two are discrete, that must be estimated by simulated maximum likelihood or generalized method of moments.

[11] For comparison, I have also applied the invalid IV probit estimator to the alternative move variables. IV probit gives a positive effect of negative equity on mobility for alternative definition 1; a practically zero effect for alternative definitions 2 and 1′; and a negative, statistically insignificant effect for alternative definition 2′. That is, even the invalid IV probit estimator does not find statistical evidence that negative equity reduces mobility. These results are available on request.

equity are less likely to move and be followed by another owner-occupant, but more likely to move and be followed by a renter or a vacancy — and 10 to 18 percent more likely to move overall, all other factors being equal. If self-reported equity is a noisy measure of true equity, and if homeowners take steps to learn their true equity before deciding whether to move, these results likely understate the true amount by which negative equity raises mobility.

3. Mobility and the depth of negative equity

As discussed above, theory suggests that a homeowner whose debt greatly exceeds the value of the home will be more likely to default (and thus move) than a homeowner whose debt only slightly exceeds the value of the home. Testing this prediction is of independent interest. In addition, the prediction provides a useful check on the coding of moves: Assuming that the theory is correct, the data should match the theory when moves are coded correctly.

I divide negative-equity homeowners into two groups: those with loan-to-value ratios between 100 percent and 114 percent (the median in the data among those with negative equity), and those with loan-to-value ratios at or above 114 percent. I then include a dummy variable for each of these groups in the probit model (1). The coefficient on a group's dummy variable measures that group's mobility relative to homeowners with non-negative equity (loan-to-value ratio at or below 100 percent), all else equal.[12] Theory predicts that mobility should be higher in the group with loan-to-value ratios at or above 114 percent than in the group with loan-to-value ratios between 100 percent and 114 percent.

Table 4 shows the results. Under all four of my alternative codings, the estimates

[12]Dividing negative-equity homeowners this way instead of including the loan-to-value ratio in the probit model prevents the small number of observations with extreme reported loan-to-value ratios from unduly influencing the results. Some homeowners report debts that are several times the reported value of their homes.

match the theory: Mobility is highest among homeowners with extremely negative equity. However, under FGT's coding, the estimates contradict the theory: Mobility is lowest among homeowners whose equity is most negative. In all cases, unfortunately, the differences between the two negative-equity groups are not statistically significant because so few homeowners in the data have negative equity. Nonetheless, to the extent that my coding of moves is correct, the data provide some suggestive evidence in favor of the theory that the depth of negative equity affects the chance that a homeowner will move.

4. Conclusion

The sharp decline in housing prices has undoubtedly wrought great hardship for many Americans. Beyond the damage to households' balance sheets, negative equity may be socially harmful if it reduces homeowners' incentives to invest in their homes and communities (Haughwout, Peach, and Tracy, 2009). But I show in this paper that, based on the available data, there is one harm that negative equity does *not* do: It does not reduce mobility. Using the same data as FGT but analyzing all the data rather than a subset of it, I find that homeowners with negative equity are at least as mobile as those with positive equity, holding other characteristics constant. Homeowners with extremely negative equity are especially mobile. The most important caveat is that the data are several years old. When more up-to-date data become available, they may of course show different effects.

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Table 1: Five ways to define moving.

		coding					observations	
year t	year $t+2$	FGT	alt. 1	alt. 2	alt. 1′	alt. 2′	equity≥ 0	equity< 0
	Interview data							
owner-occupied†	same owner-occupant	stay	stay	stay	stay	stay	53,317	1,447
owner-occupied†	new owner-occupant	move	move	move	move	move	6,266	160
owner-occupied†	renter	dropped	move	move	varies*	varies*	1,798	105
owner-occupied†	vacant interview	dropped	move	move	move	move	1,283	66
	Non-interview data							
owner-occupied†	allocated new owner-occupant	move	move	dropped	move	dropped	587	26
owner-occupied†	allocated renter	dropped	move	dropped	varies*	dropped	202	10
owner-occupied†	vacant non-interview	dropped	move	dropped	move	dropped	209	17

†Based on year-t interview or previous years' data. All observations where year t is renter occupied or vacant are dropped. *Coded as non-move if *SAMEHH* variable shows that any member of year-t household is also an occupant at $t+2$; move if *SAMEHH* shows that no member of year-t household is also an occupant at $t+2$; and dropped if *SAMEHH* is recorded as "don't know" or missing.

Table 2: Added observations with alternative definitions of moves.

	Non-negative equity			Negative equity		
Definition of moves	Non-movers	Movers	Dropped	Non-movers	Movers	Dropped
FGT	53,317	6,853	3,492	1,447	186	198
	84%	11%	5%	79%	10%	11%
Alternative 1	53,317	10,345	-	1,447	384	-
	84%	16%	-	79%	21%	-
Alternative 2	53,317	9,347	998	1,447	331	53
	84%	15%	2%	79%	18%	3%
Alternative 1′	53,958	9,636	68	1,493	336	2
	85%	15%	0%	82%	18%	0%
Alternative 2′	53,792	8,826	1,044	1,483	293	55
	84%	14%	2%	81%	16%	3%

See table 1 for definitions. Percentages may not add to 100% due to rounding.

Table 3: Probit estimates of the effect of negative equity on mobility under five definitions of moves.

	Marginal effect on probability of moving				
	(1)	(2)	(3)	(4)	(5)
Variable	FGT def.	alt. def. 1	alt. def. 2	alt. def. 1′	alt. def. 2′
Negative equity	-0.002	0.029	0.022	0.019	0.013
	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)
Observations	61,803	65,493	64,442	65,423	64,394

See table 1 for definitions of moves. All models include all of the controls listed in Ferreira, Gyourko, and Tracy (2010): fixed-rate mortgage lock-in, Proposition 13 property tax lock-in, first-time homebuyer, marital status, change in marital status, head's education, head's race, head's sex, cubic in head's age, household size, positive and negative change in household size, log real household income, positive and negative change in log real household income, positive and negative change in neighborhood quality, cubic in years in the current house, MSA fixed effects, region-specific year effects, and California-specific year effects. Estimated coefficients on the controls are available upon request. Heteroskedasticity-robust standard errors clustered by household are in parentheses.

Table 4: Probit estimates of the effect of negative equity on mobility for different levels of negative equity.

	Marginal effect on probability of moving				
Variable	(1) FGT def.	(2) alt. def. 1	(3) alt. def. 2	(4) alt. def. 1′	(5) alt. def. 2′
Negative equity	0.000	0.016	0.012	0.011	0.007
(100%<LTV<114%)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Negative equity	-0.004	0.042	0.033	0.026	0.019
(LTV≥114%)	(0.011)	(0.013)	(0.013)	(0.013)	(0.012)
p-value for equal effects	0.81	0.16	0.23	0.39	0.49
Observations	61,803	65,493	64,442	65,423	64,394

p-value for equal effects is p-value for the χ^2-test of the null hypothesis that the coefficients on negative equity (LTV <114%) and negative equity (LTV ≥114%) are equal. See table 1 for definitions of moves. All models include all of the controls listed in Ferreira, Gyourko, and Tracy (2010): fixed-rate mortgage lock-in, Proposition 13 property tax lock-in, first-time homebuyer, marital status, change in marital status, head's education, head's race, head's sex, cubic in head's age, household size, positive and negative change in household size, log real household income, positive and negative change in log real household income, positive and negative change in neighborhood quality, cubic in years in the current house, MSA fixed effects, region-specific year effects, and California-specific year effects. Estimated coefficients on the controls are available upon request. Heteroskedasticity-robust standard errors clustered by household are in parentheses.